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Newfoundland and Labrador Region | **Région de Terre-Neuve et du Labrador**

Zonal Advisory Process for the Pre-COSEWIC Assessment of Atlantic, Northern and Spotted Wolffish

September 14-15, 2010
Battery Hotel, St. John's, NL

Meeting Chairperson
Karen Dwyer

Rapporteur
N.D. Templeman

Processus de consultation scientifique zonal concernant l'évaluation pré-COSEPAC des loups atlantique, à tête large et tacheté

Les 14 et 15 septembre 2010
Hôtel Battery, St. John's, T.-N.-L.

Présidente de réunion
Karen Dwyer

Rapporteur
N.D. Templeman

Fisheries and Oceans Canada / Pêches et Océans Canada
Science Branch / Direction des science
80 East White Hills Road
St. John's NL / St. John's, T.N.L.
A1C 5X1

September 2011 | **Septembre 2011**

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made at the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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CSAS-SCCS@DFO-MPO.GC.CA

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SUMMARY

In 2000, COSEWIC assessed Atlantic wolffish (*Anarhichas lupus)* as a species of special concern; while northern (*Anarhichas denticulatus)* and spotted wolffish (*Anarhichas minor) were assessed* as threatened for the Canadian Atlantic. With proclamation of the *Species at Risk Act* (SARA) in June 2003 these wolffish species were the first marine fish in Atlantic Canada to gain protection under this legislation. COSEWIC has called for a re-assessment of the three species of wolffish and DFO, as the department for the management of these species, is required to provide up to date information on the status of the species.

A zonal science peer review meeting was held on September 14-15, 2010 in St. John's, Newfoundland to peer-review information relevant to the reassessment planned by COSEWIC of the three species of wolffish in Atlantic Canadian waters.

This meeting considered and peer-reviewed DFO information relevant to the COSEWIC status assessment for *Anarhichas lupus*, *Anarhichas minor* and *Anarhichas denticulatus* in Canadian waters, considering data related to the status and trends of, and threats to this species inside and outside of Canadian waters, and the strengths and limitations of the information. This review took into consideration the COSEWIC Quantitative Criteria and Guidelines for the Status Assessment of Wildlife Species. The information from this meeting will be made available to COSEWIC, the authors of the status report, and the Co-chairs of the COSEWIC Marine Fish Species Specialist Subcommittee. The meeting included participants from DFO Science, Ecosystem and Fisheries Management, Oceans, Habitat and Species at Risk, and Policy and Economics, as well as the Provincial Department of Fisheries and Aquaculture, Memorial University of Newfoundland, the Marine Institute, and the Fisheries, Food and Allied Workers Union.

This proceedings report summarizes the relevant discussions and presents the key conclusions reached at the peer review meeting. This will be published in the CSAS Proceedings Series. There will also be CSAS Research Documents produced in relation to the working papers presented at the workshop.

SOMMAIRE

En 2000, le COSEPAC a évalué le loup atlantique (*Anarhichas lupus)* et l'a désigné en tant qu'espèce préoccupante; de leur côté, le loup à tête large (*Anarhichas denticulatus)* et le loup tacheté (*Anarhichas minor*) ont été désignés en tant qu'espèces menacées dans le Canada atlantique. Lorsque la *Loi sur les espèces en péril* (LEP) est entrée en vigueur, en juin 2003, ces espèces de loup de mer ont été les premiers poissons marins du Canada atlantique à bénéficier d'une protection en vertu de cette loi. Le COSEPAC a demandé que ces trois espèces de loup de mer soient réévaluées, et le MPO, en tant que ministère responsable de la gestion de ces espèces, doit fournir de l'information à jour sur l'état de ces espèces.

Une réunion zonale d'examen scientifique par des pairs a eu lieu les 14 et 15 septembre 2010 à St. John's, à Terre-Neuve. Le but de cette réunion était d'effectuer l'examen par des pairs de l'information pertinente pour la réévaluation prévue par le COSEPAC des trois espèces de loup de mer dans les eaux canadiennes de l'Atlantique.

La réunion a permis d'examiner et de passer en revue l'information du MPO pertinente pour l'évaluation de la situation par le COSEPAC de *Anarhichas lupus*, *Anarhichas minor* et *Anarhichas denticulatus* dans les eaux canadiennes, y compris les données sur l'état des espèces, sur les tendances qu'elles affichent et sur les menaces pesant sur ces espèces dans les eaux canadiennes intérieures et extérieures ainsi que les forces et les limites de l'information. Cet examen tient compte du critère quantitatif du COSEPAC et des lignes directrices pour l'évaluation de la situation des espèces sauvages. L'information tirée de la réunion sera transmise au COSEPAC, aux auteurs du rapport de situation et aux co-présidents du sous-comité des spécialistes des espèces de poissons marins du COSEPAC. Parmi les personnes qui ont pris part à la réunion, mentionnons des représentants des Sciences, de Gestion des écosystèmes et des pêches, d'Océans, habitat et espèces en péril et de Politiques et économie du MPO ainsi que du ministère provincial des Pêches et de l'Aquaculture, de l'Université Memorial de Terre-Neuve, du Marine Institute et de la Fisheries, Food and Allied Workers Union.

Le présent compte rendu résume les discussions tenues par les participants et expose les principales conclusions découlant de la réunion d'examen par des pairs. Il sera publié dans la série des comptes rendus du SCCS. Des documents de recherche du SCCS liés aux documents de travail présentés à l'atelier seront également produits.

INTRODUCTION

The Chair opened the meeting with welcoming participants, explaining the CSAS process, and identifying the documents that would be coming out of the meeting – a CSAS Proceedings document capturing the details of the meeting; and CSAS Research Documents in support of the information put forward for review. A round-table of introductions ensued.

A brief overview of the role of the Science Advisory Process for wolffish species in the context of COSEWIC and SARA was provided to the audience. It was noted that under legislation of the Species at Risk Act (SARA) DFO is legally obliged to provide data to COSEWIC for their assessment. COSEWIC are a non-government, independent body of scientific experts who assess the conservation status of wildlife species; and the government must respond to COSEWIC's assessments through the SARA listing process.

In general the meeting is to peer-review DFO information relevant to the planned COSEWIC status reassessment of *Anarhichus lupus*, *A. minor* and *A. denticulatus* in Canadian waters, including considering data related to the status and trends of and threats to this species inside and outside Canadian waters, and considering the strengths and limitations of the data. This information will be made available to COSEWIC, the authors of the status report, and the Co-chairs of the Marine Fishes COSEWIC Species Specialist Subcommittee. It is not the intention/role of the meeting to debate the conclusions of the first status reports on *Anarhichus* species, or to provide advice or make recommendations. The process will, however, assist DFO in identifying any gaps in knowledge and assist with the Recovery Potential Assessment (RPA) process in case of listing changes.

The Agenda (Appendix 1) and Terms of Reference (Appendix 2) were tabled and discussed before proceeding with the presentation and review of information.

DAY 1 PROCEEDINGS

GENERAL DESCRIPTION AND LIFE HISTORY CHARACTERISTICS OF WOLFFISH

Led by Mark Simpson

Summary

Life history information for wolffish species is limited and dated, i.e., published in the 1980s based on work done in the 1960s. There are no identified spawning grounds, nursery and/or feeding areas, etc. The majority of recent information on wolffish life histories is from limited and often nearshore samples – Fishbase has also been consulted.

There is an overlap in distribution of wolffish spp. but diets are noted to be different where Northern sp. are piscivores; Spotted sp. are echinoderm benthivores; and Atlantic sp. are mollusc benthivores.

Morphological analysis has been carried out from Regional samples of 1400 wolffish from 2J to 3P (mostly Atlantic wolffish sp.). This considers 24 different characteristics, including genetics that have been sent to Memorial University for processing. Very little genetic difference has been noted and it does not appear that this information will allow separation of species into multiple DUs.

Overall, there have not been significant advances (Regionally) in our understanding of life history characteristics of wolffish spp. in recent times.

Discussion points

- There are questions as to other sources of information (i.e. US studies) that define size at maturity as 35 cm, whereas we have been using 53 cm. Therefore, this might introduce uncertainty into the current analysis of status and trends in wolffish data. Also in regard to this, depending on how a mature fish is defined, one can get very different lengths at maturity.

- Wolffish have been aged, but current aging techniques used in the Newfoundland region have not been validated. It is agreed that this would be very useful information when made available.

- While no difference in diet from north to south *within* species has been noted as being significant, there is likely a difference between populations separated by large distances, e.g. between 2J in the north and 3P in the southwest.

- It is questionable whether the variation in bottom types in small sample sizes could have affected diet studies. However, this was not a topic of the overview and has not been a consideration in any identified studies to date.

- There is no information on differences in diet for different life stages. Samples collected several years ago for this purpose have not been analysed to date for inclusion in this process.

- Recognizing that the two main sources of information for wolffish are spring and fall surveys, combining these as has been done can produce some seasonality differences within the averages.

- Notably, other information exists outside of DFO that should also be considered in the assessment of wolffish species.

INFORMATION FROM NEWFOUNDLAND AND LABRADOR REGION

Surveys (Abundance, Distribution, Area Occupied)

Led by Mark Simpson and Carolyn Miri

Summary

Surveys can provide the information required to describe abundance, distribution, and area occupied by wolffish in the NL Region. ***Abundance*** – general spring and fall surveys indicate a significant decline in the abundance of all three species of wolffish in 3LNO and 3Ps from 1978-1994 – with a general increase since that time. ***Distribution*** – is delineated using all survey information in any particular year; over a number of years. Similar patterns in the trends in Northern, Spotted, and Atlantic wolffish distribution have been observed whereby the distribution decreased significantly; increasing to a lesser extent in recent years, where movement back up onto the banks has been observed. ***Area Occupied*** – is based only on data from recent years (1995-2009). All three wolffish species across all areas have increased in area occupied over time from 1995 to present.

Decline rates were also calculated for earlier time.

Discussion points

- Anecdotal information from crab fisheries concurs with the increase in abundance and distribution occurring in Newfoundland in recent years. Information from Sentinel surveys is also available from 2005-2010, although there is no effort factored in for these. While there are no trends available to be reported from this data, the information from these surveys exists and is available.

- A notable trend occurred from the 1970s onward, where striped wolffish in 3N remained stable over time while other wolffish in this area, and all species in other areas, were exhibiting declines.

- Increases in abundance appear to be the greatest from 2006 onward. Questioning whether the increase in distribution is correlated in any way with the increase in abundance, it has been noted that point plots created from data using all years does not make this interpolation possible.

- It is recognized that points of distribution are dependant on where the survey has occurred. Therefore, it is important that areas where surveys have occurred be included with the distribution data to avoid misinterpretation of areas with no points as null sets.

- There are suggestions that since wolffish are generally solitary, any increases in abundance are less likely to be due to "pockets" of fish that might be encountered during surveys.

- To provide a better feeling for how many fish are actually being caught in the surveys that are used to create point plots for distributions, it should be noted that these numbers are often very small, i.e., 8-10 fish (or less).

- It is worth mentioning the size conversion factor used to account for the difference in the time series of individuals captured by the Engels versus the Campelen gears since interestingly enough, the trends in abundance began to increase after the introduction of the Campelen in the NL Region. It is uncertain if this was 2x or 3x.

- In Newfoundland surveys, there are differences in the catchability of wolffish using the two different survey gears where the Campelen gear (currently used; and versus Engels) picks up more juveniles – this should be considered when looking at the data and trends over time. It is preferred by COSEWIC (is required) that the information be considered on a DU basis instead of a stock basis. While aggregating stock information after the fact is possible, it is preferable to avoid bias and errors that might be introduced here (i.e. from the two time periods using different gears). However, combining areas over the same time periods pre- and post-1995 is possible where surveys are available – although timing could still be off slightly. There are problems combining the surveys, where the greatest issue is seasonal when you combine spring and fall.

- Information on trends in mature individuals contains high uncertainty due to poor length keys used in the past. The sampling is also sketchy. However, it should be noted that decline rates are not just for mature animals, but also for total population.

- Is has been suggested that confidence intervals need to be plotted or provided to COSEWIC for the survey data. At the same time, given the uncertainty in maturation size, trend lines would also be very helpful to enhancing the information. Both of these are available, but have not been presented for the current exercise.

- Other sources of fisheries and survey information on wolffish inside and outside Canadian waters exist, i.e. DFO is not the holder of all information. For example, inside Canadian waters: Russian surveys – 1972-1994; and French surveys – 1977-1999 exist. Outside Canadian waters: Spanish surveys – off the nose and tail of the Grand Banks; West Greenland surveys – publish information on Atlantic wolffish; and US surveys - 1963-2009 exist.

Commercial Fishery Removals of 3 Species of Wolffish in the Northwest Atlantic, 1960-2009

Presented by Carolyn Miri

Summary

Commercial fishery removals of three species of Wolffish in the Northwest Atlantic were examined for the period 1960-2009, using commercial data available in three databases: Northwest Atlantic Fisheries Organization STATLANT-21A unspeciated Wolffish catch data (1960-2009) reported by NAFO member countries fishing mainly outside Canada's 200 mile limit; DFO-NL ZIF (Zonal Interchange Format) unspeciated Wolffish landings data (1985-2009) reported by Canadian fishers operating within Canada's EEZ; and Canadian Fisheries Observers' speciated catch and discards data (1978-2009) collected on a set-by-set basis at sea aboard commercial fishing vessels. A brief overview of each commercial database was given. With NAFO-reported data, total reported catches of unspeciated Wolffish were investigated by year and Subarea/Division. With ZIF data, total reported landings of unspeciated Wolffish were examined by year, Subarea/Division, Wolffish bycatch/directed fisheries, and fishing gear type. With Observer data, total catches and discards of each species of Wolffish were studied by year and Subarea/Division. Observers' discards data were also prorated to ZIF total groundfish landings inside Canada's 200-mile limit to estimate Wolffish discards by year in Canada's EEZ. Commercial length frequencies for each species of Wolffish collected at sea by Canadian Observers were investigated by year, Subarea/Division, and fishing gear type. Reported catches of Wolffish have declined over the past twenty years in all Subareas/Divisions; except for an increase in catches of Atlantic Wolffish in Div. 3N (in Canada's EEZ) during 2001-2005, and a small peak of unspeciated Wolffish reported from Subarea 1 in 2003-2007. Fisheries Observer data from outside Canada's 200-mile limit in 2001-2009 indicate that the three species of Wolffish were bycaught from >0% to 27% of commercial catches by weight; with peaks observed in 2007. All commercial fishing gears catch adult Wolffish, but not young-of-the-year; except for shrimp trawls, which catch YOY but do not retain adults due to internal Nordmore grates/groundfish excluders. Commercial discarding and live release of Wolffish sometimes occurs unreported. Survival rates of Wolffish after release from fishing gear remains unknown.

Discussion points

- For the NAFO unspeciated wolffish catch data, it has been suggested that potential for increased mis-reporting by NAFO countries before the extension of the 200-mile limit could skew the interpretation of some of the numbers being presented. Therefore, Canadian landings should be separated out before this time.

- A fishery near Greenland in Subarea 1 might also skew the interpretation of some of the numbers being reported by NAFO countries.

- With respect to how wolffish data is reported, Northern and Spotted wolffish have mandatory release requirements identified in the Wolfish Recovery Strategy as per the exemption granted under Subsection 83(4) of the Species at Risk Act (SARA); which allows for certain activities to be exempt from the general prohibitions of SARA. The Section 83(4) exemption requires anyone engaging in activities which have been determined to not jeopardize the survival or recovery of the species to obtain a SARA Section 73 permit. These permits include the requirement to report the number of incidents and condition of the species in a logbook.

- In the meantime, Atlantic wolffish are allowed to be retained in 3P – therefore these are the only species showing up in ZIF data from 2004 onward. Notably, wolffish may not show up in logbooks very often because if they are released they may not be recorded in any way.

- Crab pots are not listed as catch gears in the ZIF data, yet it is known (from observer data) that wolffish is taken from this gear-type. This should be noted as a glaring discrepancy in using the data – especially since there is evidence that observers are taking measurements from these sources. Still, this means that wolffish are being released and not landed; which, overall, is a good thing.

- Observer data is speciated and prorated to total reported groundfish landings in 2GHJ3KLNOP. While there is effort available for observer data, this is not very clear in NAFO data and needs to be carefully teased out of ZIF data.

- It is possible that the observer coverage could be biasing the data made available; this has been specifically looked at on a fishery by fishery basis in the past and it would be useful to include this information.

- Yellowtail and turbot are the main fisheries out there. There is high observer coverage in yellowtail and lesser in turbot.

- It has been suggested that an improved method to consider the data would be to look at the wolffish *directed species* vs. the catches/landings.

- Uncertainties exist in the estimated wolffish discards and reported landings; uncertainties also exist in survival rates of discards.

- Experiments in the mid-2000s carried out by GEAC on survival rates estimated quite a high survival rate; although noting that this fishery was conducted in shallow waters and with a short tow.

- Fishers have noted that wolffish caught in crab pots were generally in good condition – even notably lethargic wolffish can respond once returned to water like other animals.

- Work done on the MSC for shrimp fishery shows very low reported bycatch – equaling approximately 8 fish over the entire amount of biomass that is taken. Sometimes wolffish get pinned against grates on occasion or they get funneled through.

- Observer data from shrimp trawls (mainly bottom targeting) is noted as not being consistent with the young of the young of the year (YOY) dominance of bycatch. However, the existence of a pelagic stage in wolffish might cause a difference in catchability among different fisheries.

- Notably, caution should be applied in using the commercial data, considering: commercial gears catch adults, but not young-of-the-year (YOY) (with the exception of shrimp trawls catching YOY and not adults); at-sea identification of wolffish is not mandatory; discarding and "live" release of wolffish may occur unreported; only 5-8% Observer coverage (only reliable source of information on discarding at sea) of fisheries occurs annually in Canadian EEZ; survival rates of wolffish after release from fishing gear remains unknown; and Canada's national Species-At-Risk-Act (SARA) only applies to waters inside Canada's 200-mile limit.

INFORMATION FROM GULF AND CENTRAL AND ARCTIC REGIONS

Presented by Mark Simpson

Summary

Information pertaining to the occurrence of wolffish in the Gulf and Central and Arctic Regions was sent to the lead Region (NL) for inclusion in the meeting. For the most part, the information available for these Regions is limited, coming from annual demersal surveys, and presented as catch indices. Within the Gulf Region, Striped wolffish is the most common of the three species. Populations of wolffish there are small, and so are declines. Within the Central and Arctic Region, all species occur. For the most part dedicated surveys have been infrequent, although occurring every second year recently, and trends are not available. Observer data provides the most information on wolffish through catches in the shrimp and turbot fisheries.

Discussion points

It was noted as being interesting that *A. lupus* is not caught at all in surveys, although it is directed for in Greenland. Further discussion revealed that A. lupus occupies lower temperature strata that could explain its absence in the surveys.

GENETIC DIFFERENTIATION IN WOLFFISH

Presented by Steve Carr

Summary

A new biotechnology (iterative DNA re-sequencing on microarrays) makes it possible to obtain the complete mtDNA genome sequence quickly, and with essentially 100% accuracy. This makes it possible to construct a high-resolution phylogenetic 'family tree' of individual wolffish, independent of their *a prior* assignment to management zones.

Complete mtDNA genomes from ~50 wolffish show a very shallow (i.e., young) tree, comprising three major lineages (clades). Analysis of one of these clades, including for the first time several fish with identical mtDNA genome sequences distributed across Canadian management zones, is consistent with a Poisson model of post-glacial origin from a single founding genotype, 5-10 kya. Wolffish populations are substantially less genetically differentiated and much younger than Atlantic Cod in the same geographic area.

Discussion points

- It was noted that fish genetically sampled during some experiments may not actually be from different areas, but rather different suppliers, i.e., DFO laboratories. Imslad et al. recently published an mtDNA RFLP study that claimed to find extreme micro-differentiation of Spotted and Broadhead Wolffish in the Gulf of St Lawrence: this is entirely inconsistent with the presented results, which show that the claimed polymorphisms do not exist inter-specifically, and thus are extremely unlikely to exist within species.

- Results of genetic analysis do not necessarily suggest territoriality and there is nothing to suggest that wolffish are home-bodies. Sampling to date has established the existence of a small number of separate clades, but is unable to make definitive statements about geographic patterns. It would be of value to go to a pre-determined site and test whether or not this is the case. Such a study is proposed as part of a pending FFAW-sponsored proposal by Dr Carr to NLRDC.

- The pelagic nature of juvenile wolffish, and the resulting potential for mixing, could explain some of the results from the genetic analysis presented here. Given their particular depth and strata requirements, wolffish "holes" may be expected to show micro-differentiation, if sampled on a small enough scale.

- Results on genetic differentiation in wolffish could be influenced by different behavior patterns within some species. Templeman data supported this for wolffish and it has also been reported that young Striped wolffish have been shown not to get along in a tank, but do not exhibit this behaviour as adults. Partial genetic data from the three species indicated different patterns in each.

- The results are interesting for showing the possibility that fish come from the eastern Atlantic. Johnstone et al. showed that the three Atlantic species are very closely related (about half are differentiated as the most closely related cod species); the Bering Wolffish is the sister group to these, which suggests a Nearctic/Northwest Atlantic origin.

- Genetics work on striped wolffish does not directly support the Designatable Units as they are currently defined by COSEWIC. DUs do not comprise separate lineages; rather the lineages are distributed across DUs randomly. That is, available evidence is against the notion that the geographic DUs are distinctive gene pools. The possible existence of distinctive lineages on a micro-geographic scale needs to be addressed.

INFORMATION FROM THE MARITIMES REGION

Presented by Jim Simon

Summary/Abstract

This working paper examines the DFO Research Vessel (RV) and industry surveys, extending the analysis to include USA RV surveys and examines observer and commercial landings data within the Maritimes Region. Collectively the data suggest that although Atlantic wolffish are found throughout the Maritimes Region, there are two primary areas of concentration on the Scotian Shelf in Div. 4VW and on Brown's Bank within Div. 4X. The eastern and western portions of the shelf exhibit differing trends in abundance, when examined separately for mature and immature length groups. In Divs. 4VW the abundance of mature individuals has declined by 99% since 1970, while the abundance of immature individuals has increased over the same time period. In Div. 4X, mature abundance has declined 81% since 1970, while immature abundance has declined a similar amount over the same time period. The number of immature and mature individuals as estimated for the entire survey area has averaged 2.6 and 0.3 million respectively in the survey since 2000. On the northeast peak of Georges Bank there is a small aggregation of Atlantic wolffish that appear to be spatially discrete from the remainder of the surveyed area (Div. 5Z). The decline rate since 1986 for all size classes is 99.9%. USA seasonal RV surveys, which extend from Brown's Bank to Cape Hatteras exhibit similar distributional patterns and trends in abundance to the Canadian surveys in the same areas. Only one Atlantic wolffish was caught in the US surveys southwest of Southwest Channel indicating that this is near the southern extent of the species.

Although there are no directed fisheries for wolffish in the Maritimes Region, the species is caught as a bycatch in other fisheries. Fishers have been known to make directed sets for wolffish within a trip, but they are no longer permitted to direct for the species. Annual landings of wolffish by Canada in Div 5Z have been generally below 100t since 1963, with recent landings near zero. In Div. 4X5Y, landings peaked in the late 1970s at 1600t and subsequently have declined to less than 100t in recent years. In Divs. 4VW, landings ranged from 400 to700t between 1963 and the early 1980s then declined sharply until 1993 when all directed fishing for cod and haddock ended. Since 1993 landings have been near zero.

Finer scale examinations of wolffish landings in Div.4X revealed that wolffish were concentrated on the western peak of Browns Bank, west of German Bank, and within three isolated areas that are not surveyed by the DFO RV surveys. These areas should be examined in more detail as they reflect areas of key habitat.

The composite distribution pattern from all sources on the Scotian Shelf revealed that northern and spotted wolffish are restricted primarily to the eastern Scotian Shelf including Div. 4Vn and Div. 4Vs, with some fish found along the shelf edge in Divs. 4WX. In all surveys abundance was very low with both species occurring in less than 0.5% of the sets.

The pre-COSEWIC review of the three wolffish species in 2000 determined that Atlantic wolffish were commonly caught within the Maritimes Region, but northern and spotted wolffish were relatively rare and at the southern edge of their distribution. Since 2000, Atlantic wolffish abundance has continued to decline, while abundance of northern and spotted wolffish remains very low in this region.

Discussion points

- Most of the information provided for the Maritimes has used calculations over the entire time series – not three generations. It is the feeling that the latter could produce an artificial decline over a given time versus the real significance of numbers in decline over a survey time series. Yet, it is recognized that numbers need to be reworked for presentation to fit the COSEWIC criteria (of three generations). At this time, both sets of results can be reported to show what has occurred in the population.

- Total population size is reported for Maritimes Region only. Therefore, sharp declines can occur regionally due to more weight in a few fish. This can complicate assessment at a DU level when Newfoundland is showing increases. Therefore, assessments at the DU level should consider the center of distribution at the DU level and how the information is weighted – this is the responsibility of COSEWIC.

In the past, difficulty has been encountered in assessing information at the sub-regional level. Partitioning information at the DU level may even be more complex.

- Why are adult Atlantic wolffish declining while juveniles are increasing? While unknown, this has also been observed in a number of the skates fisheries. No very large fish were noted in the Maritimes data. Could this be due to a population with a shorter generation time? Smaller size at maturity? Could many of the reported juveniles actually be adults?

- Using >53 cm as a proxy for mature individuals (35 cm is used as age at maturity in the US) can result in saying that the population is going towards extinction when using a different value would not. Uncertainty around the minimum size of mature individuals can significantly limit our appreciation of population trends.

- Wolffish in the Maritimes are known to be concentrated in "holes" of about 10's of meters in scale. It would be very interesting, from an experimental perspective, to remove about 100 individuals to test re-population. In addition, questions such as what is the feature(s) of these holes that makes an area occupied vs not occupied, could be explored.

- Northern and Spotted Wolffish are generally caught in less than 1% of RV sets (30 and 22 fish caught in 7000+ sets) in the Maritimes. More individuals of these species are represented at greater depths, e.g., wolffish show up in about 5% of redfish surveys, and wolffish occurr more frequently in halibut surveys in deeper water along the shelf edge and slope. However, caution should be used in looking at other data sets (e.g sentinel survey) as there is quite possibly an identification problem, a notable caution since these are finding a higher relative frequency of Northern and Spotted wolffish than reported in other surveys.

- Habitat preferences exist for temperature and salinity only in the Maritimes data.

INFORMATION FROM THE QUEBEC REGION

Presented by Jean Denis Dutil

Recent findings on the life history and records of wolffish (*Anarhichas* sp.) in research surveys and in the Sentinel Fisheries and Observers programs for the estuary and Gulf of St-Lawrence

Summary/Abstract

The three species of wolffish that inhabit the eastern Canadian Coast are considered as being at risk. Two species are listed as threatened (*Anarhichas denticulatus, Anarhichas minor*) whereas the third species (*Anarhichas lupus*) is listed as being of special concern. Since 2000 and 2001 when the status of those species was first assessed, the Department of Fisheries and Oceans has taken steps to facilitate their recovery. From a research and monitoring perspective, concrete actions included collecting more data and better data on which to base conservation measures in the future, as well as supporting research on life history, distribution and habitat associations of all three species. The present report reviews recent projects and publications on wolffish based on material collected in the estuary and Gulf of St. Lawrence and addressing the following topics: fish species assemblages to which wolffish are associated, use of shelters by juvenile spotted wolffish, diving and towed camera surveys, metabolism and growth, and reproductive biology, including new tools for fish identification and critical reviews of past fish identifications on research surveys. Catch and effort data were aggregated using a grid made up of 100 km^2 square cells. The probability of catching wolffish of a given species in a set and within a cell (relative occurrence) was calculated as the ratio of the number of sets in which a species was recorded and the number of sets made. This method allows the mapping of catch and effort for numerous time series based on data from different programs in both the whole study area (research surveys and Sentinel Fisheries using bottom trawls and a random stratified design) or in specific areas within the Gulf. The method also allows an estimate of surface areas occupied by each species and lends itself to matching area of occupancy and characteristics of the habitat. The data suggest no trend in abundance. Wolffish represent a small biomass compared to other demersal species, with northern wolffish being rarely caught. The west coast of Newfoundland appears to be a hot spot for the distribution of spotted and striped wolffish in the Gulf.

Discussion points

- Wolffish is one among a number of species being examined during this study in trying to identify habitat characteristics for fish spp.
- Research surveys offer almost full coverage over time – concentrations of effort and catches along the 200m contour.
- Overall, while it is uncertain as to whether there is a decline or not, there is no indication that there is an increase.
- Vessels and gear have changed over time (2004-) and surveys have been providing variable results in the Quebec Region. A 2006 review of identifications within these were found not to be as big an issue as for some other species.

- Some behavior studies have been conducted on Spotted wolffish up to 20 cm – 95% of the time fish would be found on, in or under shelter in a tank. More than one individual will share this shelter.

- Information from other sources looking at association with bottom type, e.g. mud bottoms, often have scattered boulders. Therefore wolffish may be there for this reason. Wolffish have also been observed away from structure during ROPOS expeditions.

Wolffish (*Anarhichas* sp.) landings recorded in commercial fisheries statistics (zonal interface format files - ZIF) in the estuary and Gulf of St. Lawrence.

Summary/Abstract

Commercial landings data for wolffish (*Anarhichas denticulatus*, *Anarhichas minor* and *Anarhichas lupus*) were compiled from zonal interface format files (ZIF) for NAFO divisions 4RST. Landing reports were examined to assess whether those data could provide useful information on the status of wolffish and in particular whether landings decreased over time in the study area. 47 983 landing reports corresponding to 39 667 different landings were found in the ZIF files for the period from 1985 to 2009. In the statistics, landing data were aggregated to genus (*Anarhichas* sp.), i.e., were not broken down by species, in the period from 1985 to 2004. Therefore ZIF data could not be used to examine time trends in landings by species. From 2005, most reports are broken down by species but only Atlantic wolffish (*A. lupus*) were allowed to be landed. Live weight equivalent wolffish catches summed up to 2 500 metric tons over 25 years, representing 100 tons per year in the study area, which would indicate an average landed catch of only 400 kg per year per 1 000 km^2 for the three species combined. Wolffish landed catches reported during the period from 1985 to 2009 mainly occurred during fishing activities directed toward Atlantic cod (*Gadus morhua*) and 3 species of flatfish (85 % of the reports and 95 % of total landed catch in weight of wolffish). Reports were recorded in 5 provinces and 64 different localities. Landed wolffish originated mainly from 4R : 80.7 % of total landed catch in weight in 4R, 13.1 % from 4S and only 6.1 % from 4T. In 4R, sub-divisions 4Rb, 4Rc and 4Rd were hot spots with an average landed catch of 2 112 kg per year per 1 000 km^2 for the three species and three sub-divisions combined. Two types of fishing gear, longline and gillnet, collectively contributed for two thirds of the number of landed catch reports. Longlines however accounted for as much as 72.0 % of total landed catch in weight. Despite a large variability in landings and landings per unit of effort (LPUE), there was a significant negative trend in LPUE over the period from 1985 to 2009 in 4RST. In the three subdivisions where longline landings and LPUE were greatest (4Rb, 4Rc, and 4Rd), a similar pattern was observed, i.e., a significant negative trend in LPUE over the period from 1985 to 2009.

Discussion points

- Latitude and longitude of ZIF catches is poor. The assessment of effort is also difficult, but has been attempted through counting the number of reports per/vessel/date as a proxy of effort. There were 48000 reports total; there were 8000+ multiple reports/day.

- Commercial landings typically do not identify species of wolffish. Later in the time series this is expected to be Atlantic wolffish as the others are not legal to have.

- Longlines are used more often in coastal areas and therefore would catch Striped more often than Northern wolffish.
- Observer programs have an uneven distribution of effort, and therefore, it is difficult to obtain trends over time from these. However, analyzing different sectors separately in the Quebec

Region assists with this – including trends in abundance and distribution/occurrence over time.

DAY 2 PROCEEDINGS

REVIEW OF DAY 1

The meeting Chair opened the second day of the meeting by summarizing some of the key points derived from the first day; as well as opening the floor to further discussions on issues that may not have been completely resolved following initial presentations on the topics.

Regarding information presented on general characteristics of wolffish

- Life history characteristics mainly from Templeman, but some progress in updating has been made since that time. Lots of unknowns still remain.
- Abundance and area occupied is variable across DU; with increases in Newfoundland; and variable decreases in MAR

Regarding information presented on threats (to species)

- Fishing was not specifically presented as cause of decline to this species, but it has been identified as occurring on this species. There are other threats as well to the potential recovery of woffish, i.e., environmental, oil and gas
- Notably, studies have overlaid the trawling grounds and decline rates – essentially trawled and un-trawled areas did not show a difference in the rates of decline.
- When fishing is not a direct threat, bycatch could still be an issue on a case by case basis (e.g. by region; by fishery), including potential habitat degradation. There is difference in wolffish patterns where fishing exists and does not. Notably, there is a gap between fishing and declines.
- Fishing, specifically long-line, is a major threat in the Gulf of St. Lawrence.
- The effect of juvenile mortality on declines, as well as the possibly diets of wolffish as prey to certain species studies have not been considered. However, there are existing studies that could be looked at specifically for this.
- Changes in water temperature may be a significant as the species is temperature sensitive.
- Information on bycatch in the shrimp fishery from separate Newfoundland and Maritimes studies (Orr and Scholler respectively) indicates that bycatch in that fishery is believed to be very low. Notably, bycatch could be higher on the Labrador Shelf.
- Impacts on wolffish prey (e.g., through fisheries) needs to be considered. There is information that has been grouped for analysis, but is not complete. It has been observed that Surf clam fisheries in the Maritimes exist where no wolffish have been observed historically, so this shouldn't be an issue to this area and fishery specifically.

- Specifics on how fishing effects recovery could require another meeting.

Other issues

- Survey changes over time – it may be more difficult to detect increases in the population due to reduction in tow times. This is not saying that surveys are not good; but may be more difficult to see increasing trends. The potential difference cannot be quantified as of yet.

- Number of populations – examination of genetics and populations may point to the existence of more than on DU. Are there isolated pockets (populations) that could be fished down? Notably, dispersal patterns in young stages (larvae and juveniles) can lead to genetic mixing between populations.

    - It may be useful to identify hotspots for wolffish to understand how they are isolated . It is understood that such hotspots exist for every species however. Fisherpersons may assist with this identification through experience.

- Population structure of juveniles vs. adults – there is no explanation for the high number of juveniles to adults reported in the Maritimes.

- Generation time – does generation time represent average ages in the population? This information has been taken from the literature likely using Canadian data (e.g. Templeman data), but not providing methodology for the calculation. COSEWIC uses average ages. Since we do not have data to calculate specifically, we use a proxy from the best available data – likely before the declines in the 1960s.

- Sex and maturity identification – there is the possibilty to obtain this information through blood samples and techniques used in the Quebec Region. Further information many be obtained by contacting Jean-Denis Dutil.

Research Recommandations

- Extra length frequencies on wolffish should be undertaken during surveys in Maritimes.

- It is known that there is a large area in NGSL that is not covered by survey; yet this same area is expected to be prime wolffish habitat. Effort should be made to obtain information from this area. Also would be interested in movement here – should consider tagging of fish and other work to determine migration patterns.

- Limited data on fish movements by Templeman can be supplemented with new data that shows high movement of some fish, e.g. Carr studies. Therefore, there could be sedentary and non-sedentary components of the population(s). This should be explored further.

HABITAT ASSOCIATIONS FOR WOLFFISH IN THE GULF OF ST. LAWRENCE

Presented by Jean-Denis Dutil

Summary/Abstract

A hierarchical framework has been proposed to classify marine waters surrounding North America into 24 different marine ecoregions, based on large-scale oceanographic features. One

of those ecoregions (Acadian-Atlantic) includes shelf waters from Belle Isle Strait (Canada) down to Cape Cod (U.S.A.) and encompasses the St. Lawrence estuary and Gulf. The present paper aims at proposing a hierarchical classification of the seafloor at the scale of the megahabitat for the St. Lawrence estuary and Gulf as a basis for mapping and describing marine habitats for conservation and integrated management purposes. Information on salinity, temperature, dissolved oxygen, depth, slope, variability in landscape and sediments were aggregated using a grid made up of 100 km^2 square cells. Based on that information, cluster analyses were conducted grouping cells into 13 different megahabitats. Four megahabitats described the deep waters and areas outside channels formed 9 megahabitats, four in the southern Gulf and five in the northern Gulf. These groups of cells were spatially coherent. Potential applications include the screening of areas considered for inclusion in a network of protected areas and a quantitative assessment of surface areas for each class of habitat. The method can also be applied to describe the habitat of species at risk. Using striped wolffish and relative occurrences of the species as determined using the same grid, the preferred habitat of striped wolffish was described, quantified and modeled. As much as 42% of the variability in relative occurrence could be explained by the habitat descriptors available, once the data were detrended for latitude and longitude. Areas where relative occurrences were high corresponded to areas of high probability values of the Getis-Ord Gi* statistic at a scale of 20 km. The corresponding megahabitats were identified and, where currently unoccupied by wolffish, could represent potential areas for population expansion.

Reference

Dutil, J.-D., S. Proulx, P.-M. Chouinard, D. Borcard. 2011. A hierarchical classification of the seabed based on physiographic and oceanographic features in the St. Lawrence. Rapp. tech. can. sci. halieut. aquat. / Can. Tech. Rep. Fish. Aquat. Sci. 2916: vii +72 p.

Discussion points

- From the analysis is appears that sediments with rocks and bedrocks are favorable, while oxygen is not. It was noted that work on Labrador shelf showed wolffish keeping a constant temperature by shifting depths over time.

- Wolffish may come to shallower waters in the summer and deeper waters in the winter. Otherwise, they are moving below the CIL in the winter to more preferable temperatures. Survey is a snapshot taken in the spring/summer/fall.

- The volume and extent of the CIL varies from year to year and is complex. Depending on the volume and depth, it may hit the bottom in some areas – this is mainly the SGSL in the GSL. The Laurentian Channel is too deep for this to happen there. Based on this, could make predictions on where recovery would occur if wolffish are temperature seekers. In regards to monitoring the CIL on the NL shelf, this does occur for the extent and depth of the CIL on the NL shelf and it does extend to bottom sometimes.

- Why not consider biological characteristics, e.g. predators and prey in analysis? This would be mostly included in studies of fish assemblages and communities. Assemblages do associate with habitat also though, and the information from the habitat database is there to carry out this analysis for assemblages where wolffish occur most often. Sediment types may include some of the benthic food types.

- The slope variable appears to be positively and negatively associated with wolffish habitat – can this be explained? Positive correlation with low oxygen.

- Are there plans for acoustic telemetry on wolffish in the GSL? Are females more mobile than males? When they are on open bottom, are they feeding? Wolffish must be migrating for different life history events if the food is not directly available on slopes where they hold up. This information would indeed be invaluable, especially in addressing seasonal gaps from surveys. Challenge would be recapturing tagged fish.

HABITAT ASSOCIATIONS FOR WOLFFISH IN THE NEWFOUNDLAND AND LABRADOR REGION

Presented by Mark Simpson

Summary/Abstract

Habitat associations for wolffish in the region have been summarized by Kulka et al 2004 [CSAS(2004/113)]. Direct observations in NL waters are limited to SCUBA surveys on nearshore Atlantic Wolffish (Keats et al 1985, Kulka et al 2004) during the summer and fall. In nearshore areas, Atlantic Wolffish are associated with rocks and boulders. Pelagic larval stages are influenced by near surface large scale surface circulation patterns. Depth, temperature and substrate type offshore has been examined, but Data NOT collected at scale of fish (~ 50,000x greater). Northern wolffish occupy deepest waters, with a broad distribution from 300-1200 m; spotted wolffish occupy more moderate depths with a moderate distribution of 100-800 m, and Atlantic wolffish occupy the shallowest depths with a narrow distribution from 50-450 m. Given the depths covered in most surveys, there is potential for undersampling of Northern and Atlantic wolffish species in the deepest and shallowest waters respectively. All three wolffish species are associated with a narrow temperature range – mainly 1.5-4.5 degrees C, and are virtually absent where temperatures are < 0 degrees C. Notably, during the late 1970s, wolffish were found in all temperatures, but during low abundance, each of the Wolffish species was restricted mainly to warmer locations along the outer shelf edge. Therefore these species appear to be temperature seekers, where temperature could restrict the recovery of Wolffish – a dynamic situation, in that habitat cannot be permanently geo-referenced based on this. Seabed classification data (ROXANN), was examined to derive a sediment type in the vicinity of survey trawl locations. Acoustic returns classified the sediment as either: mud, sand, sand & shell, shell & pebbles, small rock, hard bottom, or undefined. Sediment type probability distribution plots confirmed that during periods of high abundance, Wolffish are captured on ALL sediment types. However, during periods of low abundance, *A. denticulatus* occur less frequently on mud or muddy substrates relative to the occurrence of sediments in the environment. Overall, survey catch rates of *A. denticulatus* appear to be greater in areas defined as sand/shell/pebbles. *A. minor* and *A. lupus* appear to show little preference for any specific sediment type. While individual scale observations of *A. lupus* in inshore areas indicate a preference for boulder/rocky areas for spawning and avoidance of muddy substrates – comparable data are not available for the analysis for the other two species or for *A. lupus* over much of its area of distribution. Overall inadequate individual scale habitat information exists for the majority of the species range. While Wolffish can be associated with various depth and temperature profiles – it is not clear what spatial scale is relevant for wolffish habitat and how variations in temperature profiles over time affect the species' distribution. Data is limited at the scale of the species, and there is a dynamic aspect to temperature regimes at multiple spatial/temporal scales which needs to be considered.

Discussion points

- It is important to recognize that we don't have the luxury of observing at the same scale as is available on land; therefore definition of critical habitat for marine species is difficult.

- Could the cooler waters of the 1990s have been a threat or influenced decline? Also, is there any evidence of how wolffish respond to water temperatures greater than 4.5 degrees Celsius? It is uncertain, but anecdotal evidence shows physiological effects to increased temperatures, including shock and death.

    - Information from aquaculture studies might assist in answering some of the questions surrounding detrimental temperatures across various circumstances, e.g. paired with food availability, life history processes, etc. and their ability to acclimate over time. Rates of change and lethal limits could therefore be a consideration in determining recovery.

CRITICAL HABITAT – LEGAL AND POLICY PERSPECTIVES

Presented by Joe Crocker

Summary

Critical habitat has been a challenge in the past where responsible authorities have been presented with legal action when critical habitat has not been identified. As a guideline to this, identification of critical habitat does not require 100% certainty – rather, it only requires the best available knowledge, pertaining to science and otherwise. As such, the absence of certainty should not preclude critical habitat identification. However, the identification of critical habitat has geographic and biophysical requirements such that physical, biological and chemical properties can provide linkages to ecological niche. When critical habitat cannot be identified, a Schedule of Studies (SOS), as a commitment by the Minister, to address critical habitat are included in the recovery strategy to address any uncertainties. The SOS must be practical, cost effective, and able to be reasonably undertaken within timelines. Notably, every year, new species are added to SARA, so monies for critical habitat studies are decreasing over time.

Critical habitat may not exist for a species in Canadian waters when i) the species is wide ranging or a non-resident species which does not fulfill a biological requirement of their life cycle in Canadian waters; ii) the species is a transitory species; iii) the species is an extirpated species with no plan for re-introduction. A science based, peer review by DFO Science of all relevant information must be conducted and a rationale provided in the Recovery Strategy or Action Plan which explains why habitats within Canadian territory will not be considered essential to the survival or recovery of the listed species, and indicate the specific studies required to address the uncertainty. Technical, social and economic feasibility are not sufficient rationale to not identify critical habitat in Canadian waters for a species.

Discussion points

- The expectation from a Pre-COSEWIC meeting is to provide information feeding into the identification of critical habitat – as it is key to start working on this well before the Recovery Strategy. However, it is recognized that wolffish species are different because they have already been listed, and have the Recovery Strategy posted on SARA's Public Registry does not identify critical habitat, but rather contains a Schedule of Studies to facilitate such identification.

- The posted Recovery Strategy for wolffish noted critical habitat would be defined by 2008. The discussion on critical habitat was introduced to this meeting in order to complete the action plan, including identification of critical habitat if possible.

- It is recognized that legally, we have to address critical habitat – Where is critical habitat? Why is it critical? And what might destroy critical habitat?

- All of the guidance that we have has not changed – Science has to identify *habitat*, and what critical habitat *could* be – recovery planners determine whether or not they can identify critical habitat with the information available.

- We currently have a Recovery Strategy with critical habitat studies that have not been implemented. Therefore consideration should be given to what chance there is that SARA can make use of the information that is being provided on critical habitat currently. It was noted that *any* information that will shed light on critical habitat for the action plan in the present/ at this meeting would allow Regions to move forward. Critical Habitat is a component of the Action Plan which needs to be completed

- Legal challenges have occurred when the critical habitat component has either been removed and/or excluded from the information put forward. Therefore there has not been a legal challenge associated with the identification of critical habitat based on information and associated uncertainty.

ADDITIONAL GUIDANCE ON CRITICAL HABITAT AND DISCUSSIONS

All participants

Discussion points

- In the case of wolffish, there seems to be more habitat available than is required for recovery. The recovery for wolffish does not appear to be habitat limited.

- What is recovery for wolffish? Population, abundance, distribution configurations? The current goal from the Recovery Strategy is "*to increase the population levels and distribution…such that long term viability of the species is achieved.*"

- It is uncertain as to where to draw the line for recovery. Notably, the goal of the recovery strategy is to increase the populations' levels and distribution of two species of wolffish. Wolffish have recovered since the 1950s and 1960s. We could use that as guidance, based on where they have recovered from in the past (i.e. area of high concentration during period of low abundance).

- There is the suggestion that the Schedule of Studies for critical habitat should be focused on the biophysical features or the function of habitat identified for wolffish. Without this information there is not the ability to manage this habitat.

    - The existing data is too broad (scale of trawl) to focus on features and functions in a realistic manner. There are even areas that are not surveyed where we know wolffish probably exist.

- The Action Plan is being drafted by the Newfoundland Region in collaboration with other regions. The Recovery Strategy may be amended to revise the Schedule of Studies pending the outcome of critical habitat discussions.

Suggestions for identifying habitat

- Basically wolffish inhabit all waters on the banks and off the shelf – there is lots of potential habitat out there; with preference for warmer waters where available. Therefore, habitat will likely not limit the recovery of the species.

- From the data presented in this meeting, it appears that the tool, Ecological Niche Factor Analysis (ENFA), could be used for identifying wolffish habitat. In the Gulf, a BIOMAPPER experiment showed that temperature, salinity and bottom type were 3 correlated factors.

- American eels processes may provide an example –classifying habitat dimensions to identify limiting factors.

- Since we have no knowledge of life histories, could we simply take the depth zone and anything that would influence that zone to the preferred temperature and defining it as critical habitat? No, although you can identify different configurations of critical habitat.

- From a non-scientific point of view – the information provided on wolffish density in Newfoundland and Labrador, the occupancy of "holes" in the Maritimes, and information on habitat associations from the Gulf provides a starting point. These points are where we should start – recognizing certainty is not 100%. These are also where the identification of critical habitat should begin based on the area of occupancy approach.

- There is knowledge of the species' distribution at its lowest abundance, and the population has started to recover since that time. This could provide a study area to identify the biophysical requirements of wolffish.

- Caveats include scale at which the data is collected and is therefore limiting in defining the habitat.

- There may be more than one type of critical habitat, e.g. spawning, feeding – of which there is currently no information.

Identification of Critical Habitat

- The broader distribution is not viewed as being a sensible approach at this point in time. However, the fear remains that taking a minimalist approach is not enough. What if distributions are dependant on the broader distribution for ecological reasons? Therefore, providing the caveats of not using the total distribution as critical habitat should be included in the action plan and the schedule of studies.

- It should be acceptable to use minimum distribution as a starting point to critical habitat by assuming that critical habitat is contained within this.

- **Critical habitat** = minimum distribution at lowest abundance. 15 years of recovery (in NL at least) or a positive trajectory *does* support using the lowest sustainable area occupied as the criteria for critical habitat at this point in time.

- Ken Frank and Nancy Shacknell looked at "core areas" which may support this approach in defining critical habitat. These "core areas" were typically those best suited to the species for survival and eventually population growth and range expansion.

Suggestions for identifying threats to habitat

- In discussing threats on habitat we need to identify things that will prevent survival and recovery at the population/species level. However, for wolffish in particular, we do not know the specifics of the required habitat; therefore we cannot talk to the particular threats on that. Still, the minimum legal requirement is *geographical*. In the absence of the biophysical, the precautionary approach must be applied in regards to activities/threats. Unfortunately, the end result may mean over/under regulation.

- The non-jeopardy determination with regards to assessing the impact of a threat is done at the *species* level, not the individual level. The availability of a given food source can be a habitat consideration. Any activity that may impact SARA species usually goes through special review from Habitat Management.

- Habitat degradation through disruption of the bottom is a *potential threat*; no work has been done specifically on wolffish in this respect and so there is no direct evidence, only a hypothesis.

- Oil and gas exploration and production – may be a potential threat, and should be listed as such based on the likelihood for it to occur in the area. There is much more oil and gas activity out there now than there ever was before and there will be more in the future than today. There is a need to highlight threats in addition to fishing.

- Fishing gears – see DFO (2010) Potential impacts of fishing gears (excluding mobile bottom-contacting gears) on marine habitats and communities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/003).

- Climate change could be a threat. However, we are unable to quantify this, or specify its impact.

- Nothing appears to affect habitat preferences such as temperature, salinity, rocky sediments, and variability of slope. If taking into consideration corals (which we have not identified), this may be different.

- For threats, if an activity is ongoing in an area where critical habitat has been identified and there has been an increase in the population since, how can we argue that the activity is a threat to critical habitat?

General observations on habitat

- There will never be enough resources to get to where we wanted/want to go with respect to critical habitat identification for wolffish, but in the meantime we need to scale down expectations created by the existing Schedule of Studies.

- There are large and small scale characteristics, spatially and temporally, that are applicable to the information put forward on critical habitat. However, this depends on the scale at which the information is acquired and analyzed. This will influence what and how you define critical habitat – and also the threats to this.

- We know wolffish did occupy nearly all of the waters of the Northwest Atlantic, and in large numbers. They are probably still currently everywhere (as broadly distributed), but just in very low numbers/density. Also, depending on how you define recovery, we do have an increasing trajectory for all three spp.

- For applying the concept of minimal area, it is important that the caveats are provided for people to be comfortable. Therefore, critical habitat *may* be minimum area of distribution during minimal abundance. However, this doesn't appear to apply in all Regions – only Newfoundland and Labrador and Gulf. Another option is to draw polygons around places where there has been minimal abundance or to identify where 90% abundance currently/has occurred. It is agreed that while the minimum area may not be sufficient, starting with the core of distribution is.

- In regards to the importance of shelters/residence (rocks and crevices), based on inshore observations of habitat requirements, it is likely that there were enough shelters within the minimum area occupied for population increases to have occurred. Atlantic wolffish has been found to be associated with rocks in a few areas. The other two species have no observations to this end. Atlantic wolffish in the lab spend 95% of time around rocks – 1% in water column. Knowledge on shelter/residence for other species and in other areas would have to be extrapolated from this with caution and further research.

- Shelters/residence may be located both within and outside critical habitat under SARA.

Research Recommendations

- Mapping exercises to expand on minimum distributions and caveats

- Research on functions and attributes of habitat, e.g., for different life history stages, protection.

- Identification of closed areas – and note how these can afford added protection, i.e. closed shrimp areas, NAFO area, etc.

- Without the resources to conduct a large scale project – test the hypothesis that "holes" are important – potentially as part of critical habitat. Finding the physical characteristics of this "hole" can be used to extrapolate this information to the offshore to designate areas of critical habitat.

- The determination of residence through research, because there is good evidence to support this for striped wolffish (but none for the two species listed as threatened), is not applicable to the SOS because the concept of residence is an *individual* concept – it is not related to critical habitat.

ROUNDTABLE/CONCLUSIONS

Several key points stood out specific to the information provided on wolffish species against the Terms of Reference during the meeting:

- Life histories of wolffish species are based on mainly old/dated information
- Uncertainties exist surrounding age at maturity in wolffish and may not be appropriate for calculating generation time.
- Trends in population size in Newfoundland and Labrador (where analysis did not combine gears while others did) show that population declines have ceased and are reversing.
- Trends in the Maritimes show continuing decreases in some areas and no change in some other areas; may be some evidence of reversal of declines in some limited areas.
- **Critical habitat** = minimum distribution at lowest abundance. 15 years of recovery (in NL at least) or a positive trajectory *does* support using the lowest sustainable area occupied as the criteria for critical habitat at this point in time.
- Bottom contact fishing gears and oil and gas are likely the only possible threats to habitat - when unmitigated.
- Genetics may be used to further inform COSEWIC definition of DUs for wolffish

Unresolved Issues

- It was noted that the information put forward did not look at the proportion of population inside and outside of Canadian waters as these are considered contiguous. However, it is agreed that domestically, we definitely have only a portion of the population. There might be a NAFO document available that addresses this.
- We have not provided much information on predation of wolffish. In some diet studies, sea ravens appear to consume wolffish more than many other groundfish, and a new masters student looking at diet of grey seals on the west coast of NL may be able to shed light on the effects of seal predation.
- The center of concentration for the species has not been calculated, but is available for the NL Region, where there have been some shifts. This information is not likely easy to calculate for the DU.

It was recognized that the information presented during the meeting will need to be provided to the COSEWIC author in a form more than merely figures – this will also require electronic files of all tables and numbers (associated data).

APPENDIX I - AGENDA

Draft Agenda

Wolffish Pre-COSEWIC Zonal Review Meeting

Battery Hotel and Suites, 100 Signal Hill Rd., St. John's, NL
14-15 September, 2010

Chairperson: Karen Dwyer

Tuesday, September 14, 2010		
0830	Arrival - refreshments	
0900	Introduction (Chair) • Outline of Pre-COSEWIC process • Review Terms of Reference/Agenda • Roundtable introduction	Karen Dwyer
0930	General description and life history characteristics • Discussion	Mark Simpson
1000	Information from Newfoundland and Labrador Region • Surveys (Abundance/Distribution/Area Occupied)	Mark Simpson
1030	***BREAK***	
1045	Information from Newfoundland and Labrador Region • Threats	Carolyn Miri
1115	Information from Gulf and Central and Arctic Regions • Surveys (Abundance/Distribution/Area Occupied)	Mark Simpson
1200	***LUNCH***	
1300	Genetic Differentiation in wolffish species	Steve Carr
1345	Information from Maritimes Region • Surveys (Abundance/Distribution/Area Occupied) • Threats	Sherrylynn Rowe Jim Simon
1445	***BREAK***	

1500	Information from Quebec Region • Surveys (Abundance/Distribution/Area Occupied) • Threats	Jean-Denis Dutil
1600	Group Discussion	ALL
1700	***ADJOURN***	

Wednesday, September 15, 2010		
0900	Arrival - refreshments	
0930	Review of previous days discussions • Identification and prioritization of unresolved issues	Karen Dwyer
1015	***BREAK***	
1030	Habitat Associations for Wolffish in the Gulf of St. Lawrence	Jean-Denis Dutil
1115	Information on Regional Habitat Characteristics • NL • Quebec • Maritimes	Mark Simpson
1200	***LUNCH***	
1300	Critical Habitat – Legal and Policy perspectives	Joe Crocker
1330	Additional guidance on Critical Habitat	ALL
1400	Critical Habitat – Discussion	ALL
1445	***BREAK***	
1500	Identification and prioritization of additional unresolved issues	
1530	Discussion of other sources of information	
1600	Roundtable/Conclusions	
1700	***ADJOURN***	

APPENDIX II – TERMS OF REFERENCE

Zonal Advisory Process –
Newfoundland and Labrador, Central and Arctic, Gulf, Maritimes, Quebec
September 14-15, 2010

Battery Hotel, St. John's (NL)

Chairperson: Karen Dwyer

Context

The implementation of the federal Species at Risk Act (SARA), proclaimed in June 2003, begins with an assessment of a species' risk of extinction by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC is a non-government scientific advisory body that has been established under Section 14(1) of SARA to perform species assessments which provide the scientific foundation for listing species under SARA. Therefore, an assessment initiates the regulatory process whereby GiC must decide whether or not to accept COSEWIC's assessment and add a species to Schedule 1 of SARA, which would result in legal protection for the species under the Act. If the species is already on Schedule 1 of SARA, the GiC may decide to keep the species on the list, reclassify it as per the COSEWIC assessment, or to remove it from the list (Section 27 of SARA).

Three species of wolffish, *Anarhichas lupus*, *Anarhichas minor* and *Anarhichas denticulatus* have been listed by COSEWIC for reassessment. DFO, as a generator and archivist of information on marine species, is to provide COSEWIC with the best information available to ensure that an accurate assessment of the status of a species can be undertaken.

Anarhichas minor and *Anarhichas denticulatus* were both previously classified as Threatened, while *Anarhichas lupus* was listed as Special Concern by COSEWIC. With proclamation of SARA in June 2003 these wolffish species were the first marine fish in Atlantic Canada to gain protection under this legsislation. Each species was previously classified by COSEWIC as one designatable unit within its range in Canada.

Objectives

The overall objective of this meeting is to peer-review DFO information relevant to the COSEWIC status assessment for *Anarhichas lupus*, *Anarhichas minor* and *Anarhichas denticulatus* in Canadian waters, considering data related to the status and trends of, and threats to this species inside and outside of Canadian waters, and the strengths and limitations of the information. This information will be made available to COSEWIC, the authors of the species status report, and the co-chairs of the applicable COSEWIC Species Specialist Subcommittee. Output from the peer-review meeting (see below) will be posted on the CSAS website.

Specifically, DFO information relevant to the following will be reviewed to the extent possible:

1) Life history characteristics

- Growth parameters: age and/or length at maturity, maximum age and/or length
- Total and natural mortality rates and recruitment rates (if data is available)
- Fecundity

- Generation time
- Early life history patterns
- Specialised niche or habitat requirements, including critical habitat

2) Review of designatable units

Available information on population differentiation, which could support a COSEWIC decision of which populations below the species' level would be suitable for assessment and designation, will be reviewed. Information on morphology, meristics, genetics and distribution will be considered and discussed.

See COSEWIC 2008 "Guidelines for Recognizing Designatable Units below the Species Level" (http://www.cosewic.gc.ca/eng/sct2/sct2_5_e.cfm)

3) Review the COSEWIC criteria for the species in Canada as a whole, and for each designatable units identified (if any)

(http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm)

COSEWIC Criterion – Declining Total Population

a. Summarize overall trends in population size (both number of mature individuals and total numbers in the population) over as long a period as possible and in particular for the past three generations (taken as mean age of parents). Additionally, present data on a scale appropriate to the data to clarify the rate of decline.

b. Identify threats to abundance - where declines have occurred over the past three generations, summarize the degree to which the causes of the declines are understood, and the evidence that the declines are a result of natural variability, habitat loss, fishing, or other human activity.

c. Where declines have occurred over the past three generations, summarize the evidence that the declines have ceased, are reversible, and the likely time scales for reversibility.

COSEWIC Criterion – Small Distribution and Decline or Fluctuation: for the species in Canada as a whole, and for designatable units identified, using information in the most recent assessments:

a. Summarize the current extent of occurrence (in km2) in Canadian waters

b. Summarize the current area of occupancy (in km2) in Canadian waters

c. Summarize changes in extent of occurrence and area of occupancy over as long a time as possible, and in particular, over the past three generations.

d. Summarize any evidence that there have been changes in the degree of fragmentation of the overall population, or a reduction in the number of meta-population units.

e. Summarize the proportion of the population that resides in Canadian waters, migration patterns (if any), and known breeding areas.

COSEWIC Criterion – Small Total Population Size and Decline and Very Small and Restricted: for the species in Canada as a whole, and for designatable units identified, using information in the most recent assessments:

a. Tabulate the best scientific estimates of the number of mature individuals;

b. If there are likely to be fewer than 10,000 mature individuals, summarize trends in numbers of mature individuals over the past 10 years or three generations, and, to the extent possible, causes for the trends.

Summarize the options for combining indicators to provide an assessment of status, and the caveats and uncertainties associated with each option.

For transboundary stocks, summarize the status of the population(s) outside of Canadian waters. State whether rescue from outside populations is likely.

4) Describe the characteristics or elements of the species habitat (including critical habitat) to the extent possible, and threats to that habitat

Habitat is defined as "in respect of aquatic species, spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced".

Critical Habitat s 2.(1) "means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species"

The phrasing of the following guidelines would be adapted to each specific species and some could be dropped on a case-by-case basis if considered biologically irrelevant. However, these questions should be posed even in cases when relatively little information is expected to be available, to ensure that every effort is made to consolidate whatever knowledge and information does exist on an aquatic species' habitat requirements, and made available to COSEWIC.

a. Describe the functional properties that a species' aquatic habitat must have to allow successful completion of all life history stages.

In the best cases, the functional properties will include both features of the habitat occupied by the species and the mechanisms by which those habitat features play a role in the survivorship or fecundity of the species. However, in many cases the functional properties cannot be described beyond reporting patterns of distribution observed (or expected) in data sources, and general types of habitat feature known to be present in the area(s) of occurrence and suspected to have functional properties. Information will rarely be equally available for all life history stages of an aquatic species, and even distributional information may be missing for some stages. Science advice needs to be carefully worded in this regard to clearly communicate uncertainties and knowledge gaps.

b. Provide information on the spatial extent of the areas that are likely to have functional properties.

Where geo-referenced data on habitat features are readily available, these data could be used to map and roughly quantify the locations and extent of the species' habitat. Generally however, it should be sufficient to provide narrative information on what is known of the extent of

occurrence of the types of habitats identified. Many information sources, including Aboriginal Traditional Knowledge (ATK) and experiential knowledge, may contribute to these efforts.

c. To the extent possible, describe the critical habitat of the species, including the geographic area and biological and physical attributes of that area The methodology used to determine the critical habitat should also be described.

d. Identify the activities most likely to threaten the functional properties, and provide information on the extent and consequences of those activities, including threats to critical habitat.

COSEWIC's operational guidelines require consideration of both the imminence of each identified threat, and the strength of evidence that the threat actually does cause harm to the species, or its habitat. The information and advice from the Pre-COSEWIC review should provide whatever information is available on both of those points. In addition, the information and advice should include at least a narrative discussion of the magnitude of impact caused by each identified threat when it does occur.

e. Recommend research or analysis activities that are necessary

Usually the work on the other Guidelines will identify many knowledge gaps.

Recommendations made and enacted at this stage in the overall process could result in much more information being available should a RPA (Recovery Potential Assessment) be required for the species.

5) Describe to the extent possible whether the species has a residence as defined by SARA

SARA s. 2(1) defines Residence as "a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating."

6) Threats

A threat is any activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioural changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur. Guidance is provided in: *Environment Canada, 2007. Draft Guidelines on Identifying and Mitigating Threats to Species at Risk. Species at Risk Act Implementation Guidance.*

List and describe threats to the species considering:

- Threats need to pose serious or irreversible damage to the species. It is important to determine the magnitude (severity), extent (spatial), frequency (temporal) and causal certainty of each threat.

- Naturally limiting factors, such as aging, disease and/or predation that limit the distribution and/or abundance of a species are not normally considered threats unless they are altered by human activity or may pose a threat to a critically small or isolated population.

- Distinction should be made between general threats (e.g. agriculture) and specific threats (e.g. siltation from tile drains), which are caused by general activities.

- The causal certainty of each threat must be assessed and explicitly stated as threats identified may be based on hypothesis testing (lab or field), observation, expert opinion or speculation.

7) Other

Finally, as time allows, review status and trends in other indicators that would be relevant to evaluating the risk of extinction of the species. This includes the likelihood of imminent or continuing decline in the abundance or distribution of the species, or that would otherwise be of value in preparation of COSEWIC Status Reports.

Working Papers

Working papers addressing the above terms of reference will be submitted for review:

Output of the meeting

The final version of the minutes of the meeting will be part of the CSAS Proceedings series. CSAS Research documents are expected from the working papers submitted for review.

Participation

Participation is expected from:

- Relevant DFO Sectors
- COSEWIC status report author

Participation may also include:

- Industry
- Aboriginal groups
- ENGO's
- Academia
- Other invited external experts as deemed necessary

APPENDIX III - PARTICIPANTS

Name	Affiliation	Phone	Email
Lindsey Blades	DFO	(709) 772-5314	Lindsay.Blades@dfo-mpo.gc.ca
Steven Carr	MUN (Biology)	(709) 864-4776	scarr@mun.ca
David Coffin	DFO	(709) 772-2916	David.Coffin@dfo-mpo.gc.ca
Joe Crocker	DFO	(613) 991-0050	Joe.Crocker@dfo-mpo.gc.ca
Erin Dunne	DFO	(709) 786-3122	Erin.Dunne@dfo-mpo.gc.ca
Jean-Denis Dutil	DFO	(418) 775-0582	Jean-Denis.Dutil@dfo-mpo.gc.ca
Karen Dwyer	DFO	(709) 772-0573	Karen.Dwyer@dfo-mpo.gc.ca
Harvey Jarvis	FFAW	(709) 576-7276	hjarvis@ffaw.nfld.net
Dave Kulka	DFO (retired)		Dave.Kulka@dfo-mpo.gc.ca
Melissa Landry	DFO	(613) 991-0298	Melissa.S.Landry@dfo-mpo.gc.ca
Carole L LeBlanc	DFO	(506) 395-7722	Carole.L.LeBlanc@dfo-mpo.gc.ca
Atef Mansour	DFO	(709) 772-4133	Atef.Mansour@cfo-mpo.gc.ca
Luiz Mello	DFO	(709) 772-2060	Luiz.mello@dfo-mpo.gc.ca
Carolyn Miri	DFO	(709) 772-0471	Carolyn.Miri@dfo-mpo.gc.ca
Simon Nadeau	DFO	(613) 991-6863	Simon.Nadeau@dfo-mpo.gc.ca
Joan O'Brien	DFO	(709) 772-3150	Joan.OBrien@dfo-mpo.gc.ca
Fred Phelan	DFO	(709) 772-6931	Fred.Phelan@dfo-mpo.gc.ca
Bret Pilgrim	DFO	(709) 772-6562	Bret.Pilgrim@dfo-mpo.gc.ca
Nancy T. Pond	DFA	(709) 729-1532	nancypond@gov.nl.ca
Craig Purchase	MUN (Biology)	(709) 864-4452	cfpurchase@mun.ca
Red Méthot	AECOM	(819) 373-6820	Red.Methot@aecom.com
Sherrylynn Rowe	DFO	(902) 426-8039	Sherrylynn.Rowe@dfo-mpo.gc.ca
Philip Sargent	DFO	(709) 772-5430	Philip.Sargent@dfo-mpo.gc.ca
Jim Simon	DFO	(902) 426-4136	Jim.Simon@dfo-mpo.gc.ca
Mark R Simpson	DFO	(709) 772-4841	Mark.R.Simpson@dfo-mpo.gc.ca
Nadine Templeman	DFO	(709) 772-3688	Nadine.Templeman@dfo-mpo.gc.ca